

# **1st Annual Classroom Telecommunications Conference**

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*Consortium for the Application of Space Data to Education*  
CASDE

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## Background

Since the days of Sputnik, scientists and engineers have gathered data, developed information and created knowledge from space-based sensors. The legacy from the National Aeronautics and Space Administration is unprecedented. Robotic sensors have returned data from throughout the solar system including all of the planets except Pluto, most of the moons of the planets, some asteroids and comets, and the sun itself. The dim, fuzzy telescopic images of distant worlds are replaced with sharp images, computer rendered fly-overs, and surface photography. Beyond our solar neighborhood, the Hubble Space Telescope has returned pictures of the farthest known areas of the universe and the birthplaces of stars.

The Earth has been imaged in virtually all electromagnetic wavelengths. Satellite based pictures are easily available at better than meter resolution for most of the world. In selected areas, intelligence sensors have returned pictures at better than one meter resolution. Intricate data sets chronicle changes to the Earth's environment. Volcanic ash, polluted river effluents all can be tracked with a precision undreamed a few decades past.

We are challenged to use this knowledge to impart knowledge, excite, and engage today's children. With some notable exceptions, most of the amassed holdings are cataloged in an ad hoc, arcane manner. Software to access, analyze, and manipulate this data is difficult to find and use. The irony is that in an age marked by such an overwhelming wealth of data there is a poverty of accessible and usable information available to the educational community.

The Consortium for the Application of Space Data to Education (CASDE) was formed to make space data holdings more easily accessible to educators and students. CASDE will take an even greater step and work with educators to develop specific sets of data and information, and concomitant software to apply these holdings to specific curricula in a diverse set of subjects.

## CASDE: Overview

In February of 1993, Senator Bob Kerrey of Nebraska held a meeting to challenge the managers, engineers and scientists of the Jet Propulsion Laboratory to find better ways to apply NASA's space data holdings to education. Zygielbaum formed a study group to consider alternatives. The result was the creation of the CASDE.

CASDE was created to organize, enhance, and disseminate NASA analytical tools, data and information for educational use. It is the intent to catalog and categorize significant portions of existing and new data holdings in a context facilitating educator and student access. CASDE will facilitate use of these data by making available visualization techniques developed at the Jet Propulsion Laboratory and the Goddard Space Flight Center.

To avoid this effort from being an abstract exercise, CASDE will work with designated educators, schools, and classroom to demonstrate data and tool applicability to science education, initially at the high school level. Sample lessons and other educational resources will be created which can be readily incorporated into curricula or used in individual learning. Eventually CASDE participants will apply these to other fields, such as history, and extended to other grade levels.

CASDE will create a center to host, provide access to, and disseminate materials. Although the primary means of dissemination will be electronic, CASDE will distribute materials by CDROM or other appropriate media. In any case, all electronic interfaces to CASDE will use a uniform, "user-friendly" format, perhaps based on HTML products such as MOSAIC or NETSCAPE.

#### CASDE: Initial Partners

CASDE is a partnership of national laboratories and educational institutions. The effort is jointly lead by the California Institute of Technology's Jet Propulsion Laboratory (JPL, a NASA sponsored Federally Funded Research and Development Center) and the University of Nebraska Lincoln's Center for Advanced Land Management information Technologies (UNL/CALMIT). The other initial participants are The John Hopkins University Institute for the Academic Advancement of Youth (JHU / IAAY), and NASA's Goddard Space Flight Center (GSFC).

JPL brings image processing, visualization, and data management technology and resources derived from its role as NASA's lead center for the robotic exploration of space. At JPL, the Data Distribution Laboratory (DDL) and Planetary Data System (PDS) will provide the focus for the development of cataloging, interface, and distribution mechanisms. The Digital Image Animation Laboratory (DIAL) is a world-class facility developing visualization tools and techniques. DIAL will be the focal point for rendering images into three dimensional pictures and animations.

CALMIT provides information derived from remote sensing to Nebraska's research organizations, state government, agricultural concerns, and industry. CALMIT will be responsible to create CASDE's access and dissemination center. The hub of this activity has been dubbed CASDE Home. UNL will bring to bear its rich data and information resources and skills in managing earth resource data.

The success of CASDE depends entirely on the coupling between its technical and education efforts. IAAY will lead the formal education effort. Johns Hopkins University is world renown for its contributions to K-12 education. Its Center for Talented Youth, now expanded to IAAY, has not only impacted individual achievement but has develop seminal techniques in engaging youth in learning. IAAY will provide CASDE's focus in educational product and process development and in the accommodation of public policy. This latter is a recognition that CASDE's success also depends on the applicability of CASDE products to publicly mandated standards, frameworks, and other content requirements.

The National Space Science Data System (NSSDC) at Goddard Space Flight Center is NASA's primary data access and distribution facility. Along with the Earth Observing System Data and Information System (EOSDIS), NSSDC will provide significant data resources to the participants in C. ASDE. GSFC also has essential experience in the management of data, in mechanisms for distribution, and in data visualization.

As CASDE matures, other organizations will become partners or associates. For example, the Nebraska and California State Systemic Initiative organizations (sponsored by the National

Science Foundation), as well as other systemic initiative organizations will be used to increase the number of CASDE participants. As appropriate, other universities will be brought in for their contributions in educational processes and products such as Montana State University (mathematics visualization), the University of South Dakota (application of earth resource data), and the University of Michigan, AM Arbor, (multimedia products and electronic libraries).

#### CASDE: Repository and Clearinghouse

CASDEHome will be a data and information server to be established at CALMIT. As a repository and clearinghouse, CASDEHome will contain all products resulting from this project. It will include unique data sets, pointers to applicable data held at other facilities, information about data, and education products. Access to CASDE will be available via Internet initially limited to CASDE participants, and eventually to the public at large.

CASDE will be a clearinghouse for education products relating to space science data. Products developed or adopted by CASDE will be available on the server. Metadata, that is data about data, will provide users with the ability to quickly ascertain the applicability of data holdings to educational applications. Metadata will be organized and developed in an educational context. Metadata will include information on related curriculum, educational applications, age group of interest, etc. CASDEHome will house a local repository of NASA and other agency data that is key to its educational products. Gateway services to other data centers such as JPL's PDS or Goddard's NSSDC will minimize duplication of data holdings and keep the size of CASDEHome manageable. From the standpoint of an educator or student participant, all information relevant to a CASDE educational product will be electronically contained within CASDE, directly or through a gateway service.

Several media will be used for the dissemination of products. Internet will provide the most immediate access for most users. Online resources will include browsing, data download, user support, and product ordering. CDROMs will be used to deliver large amounts of stable data and related information. CASDE will explore the use of CDROM for the distribution of most resources while providing update and change information online. This will minimize redundant overhead use of the Internet. Regardless of the media, a common interface will ease user training. The Interface will probably be based on HTML through a product such as Mosaic or Netscape.

One of CASDE's goals is to provide end-t-end user support. This will range from responding to specific questions about CASDE products through directing the user to a specific source for vendor-specific help. CASDE will also consult on the application of education products and provide references to related products and services.

#### CASDE: Visualization Tools

Most satellite images are intricate top-down views. While interesting, they are typically hard to interpret by those outside a specific field of interest. Given modern visualization techniques, these same images can be combined with digital topographic data and rendered into three dimensional perspective views. These are easily interpreted and much more engaging to the lay observer. CASDE will make available visualization tools and resources and take advantage of this better way to present information.

Commercial products such as Virtual Reality Laboratory's Vistapro are readily available and inexpensive. They can provide an Introduction to visualization for most users. Public domain products developed by JPL, Goddard, and others are much more capable, but require expensive workstations. CASDE will develop a means by which a flight script developed on a product

like Vistapro can **be used to direct** the rendering of high resolution **perspective** views and animations. A student or educator would then be able to develop and **evaluate** a view or flight using Vistapro, send the resulting **script** to CASDEHome and receive back a high resolution rendering via CDROM or the Internet. This remote rendering capability will give **educators** access to the most advanced rendering capability available. Other mechanisms and products will be evaluated for inclusion in CASDE.

Visualization and **image** processing techniques will also allow students to have "virtual instruments". A user will be able to examine a scene **in**, for example, visible, infrared, or radio wavelengths. One can even imagine "virtual eyes" that would allow viewing a scene as an insect or animal **might** see it.

CASDE will also explore the use of visualization techniques to represent **nonimage** data sets in new ways.

#### CASDE: Learning Objectives and Educational Content

The primary educational objective is to provide an interactive learning environment which utilize< the data holdings of NASA. CASDE is a partnership among educators, students and technologists. By creating "curricular partners" educators make their needs known to technologists who in an iterative and interactive fashion provide technology, data, and information to satisfy the educational requirement. Reliance is placed on world class educators. John Macguire, California Teach of the Year and expert in math curriculum, **will** head the team of educators. Roger Kassebaum, a very successful physics teacher and expert in educational technology from Omaha's Millard North High School, is one of the key participants.

Workshops are planned to **involve pilot sets of teachers in identifying** needs, establishing mechanisms to accommodate those needs, and begin the development of appropriate curriculum guides. Teacher training is an integral part of the effort. CASDE will design user friendly training **materials to accompany all data and data analysis tools.**

Pilot schools will be identified to test concepts and assure the appropriateness and transferability of teaching modules. The initial pilots will be in Pasadena, CA, and Lincoln, NE. Special emphasis will be placed on the Pasadena pilot to test and evaluate methods and products less reliant on online access and high technology availability.

CASDE will rely upon the experience and relationship developed between IAAY and the Pasadena school district over several years of interaction through Center for Talented Youth programs. The project will similarly rely upon the experiences of Nebraska's State Systemic Initiative in developing curriculum and encouraging reform in math and science education.

By the end of 1996, CASDE will develop lesson plans that use remotely sensed data in specific subject areas. These will be developed using participating pilot teachers. Workshops conducted by the CASDE partners will be used to help in the development of prototype instructional frameworks. The pilot teachers will also be expected to work within their home schools to create an extended group of educators who are adopting and integrating remotely sensed data **into their existing curricular designs.**

By the end of 1997, CASDE will create curricular guides that integrate developed data, information, **and technology into high school curriculum.** While the focus may change as experience is **gained, the current thought is that** CASDE will **focus on lessons that enrich current science and geography** curriculum standards,

## CASIDE: A Vision

One day, a child will click on a computer screen to study the path taken by Lewis and Clark on their epic journey. Rather than a sterile graphic map of the path of their sojourn, the student will be taken on a three-dimensional virtual voyage along the path of discovery. The data will be real, taken from a NASA satellite. Through the magic of image processing, the student will view the data as a virtual reality flight seen from the seat of an aircraft. The student will then be able to access data and curriculum-based materials that relate to the Lewis and Clark experience. The link from story to comprehension and imagination to science, geography and other subjects will be measurably shortened.